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AUTHOR Myers, Betty
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ABSTRACT

This is a model to find out if a problem-solving process can be specified clearly enough to be modeled by a computer, thus providing a simulation which can be used to train preservice teachers to use this process to solve classroom problems. In the model, the teacher trainee must respond to eight successive questions which form a strategy to analyze the problem defined. The answer to each question must be consistent with the trainee's goal, that is, the solution to his problem. After answering the questions, the trainee records the questions and his answers on a computer. The proof of his success is the acceptance of the answers by the computer since they are monitored for consistency. If the proposed solution is accepted by the computer, it is then evaluated according to its plausibility. If the solution passes this criterion, it can then be put into practice. This model is currently inoperative since the consistency criterion must be defined operationally for the computer. (PD)

THE FEASIBILITY OF A COMPUTER SIMULATION FOR IMPROVING CONSISTENCY IN CLASSROOM PROBLEM SOLVING

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Betty Myers, The Ohio State University

Purposes of the study.

The study had two purposes. The first was to find out if a problem-solving process could be specified so clearly that it could be modeled by a computer. This was the simulation. The second purpose was to use the simulation to train preservice teachers to use the process. The problems to be solved are classroom problems as perceived by teachers.

Illustration of the kind of problems of interest.

In order to make clear the kind of classroom problems being considered a specific problem situation and one teacher's reaction to it will be illustrated in a film from the Teaching Problems Laboratory.[1] The teacher in the film, who is not seen but whose words are read from subtitles, is Pat Taylor and the pupils are fifth-graders. The disruptive pupil is Jack Brogan. There are two questions of interest with regard to the film and the simulation. They are (1) what problem was Pat Taylor attempting to solve and (2) how successful were the attempted solutions. (The film of "Critical Teaching Problem I" should be shown here. A description of the problem appears in the Appendix.)

With respect to the first question, if the problem presented here was perceived as "having my class disrupted," then the goal might be to reduce

[1]Donald R. Cruickshank, Frank W. Broadbent and Roy L. Bubb, Teaching Problems Laboratory (Chicago: Science Research Associates, Inc., 1967)

the disruption and a solution to achieve this goal should be an action that can do this. Consider Pat Taylor's solution. It could be argued that that wasn't the effect of that solution at all. Every time Jack's actions were disruptive Pat's solution was to tell him, from across the room, to resume his work. Jack disturbed some of the pupils, but every time Pat spoke to Jack everyone stopped whatever work they were doing to listen. The teacher's actions disturbed more pupils than Jack's did. If the teacher perceived the problem as "having my class disrupted," this solution obviously did not solve that problem.

Other interpretations of the problem are possible. This one was used to illustrate how teachers attempt to solve problems with solutions that don't work. It is hypothesized that this occurs when teachers are unclear about what their goals are and how their goals are related to the solutions they use. The next question to be considered is how could a teacher learn to identify a goal and propose solutions for a specific problem that would help him to achieve the goal.

Need and intention of the study.

Since teachers report that they have persistent, unresolved problems[2-5]

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[2]Donald R. Cruickshank and Frank W. Broadbent, The Simulation and Analysis of Problems of Beginning Teachers (Final Report Grant No. USOE 22-6000A. Washington, D. C.: U. S. Department of Health, Education and Welfare, Office of Education, Bureau of Research, October, 1968)

[3]Donald R. Cruickshank and James Leonard, The Identification and Analysis of Perceived Problems of Teachers in Inner-City Schools (The NDEA National Institute for Advanced Study in Teaching Disadvantaged Youth. Occasional Paper/One. Wachington, D. C.: The American Association of Colleges for Teacher Education, 1967)

[4]Donald R. Cruickshank, John J. Kennedy, James Leonard and Robert Thurman, Perceived Problems of Teachers in Schools Serving Rural Disadvantaged Populations: A Comparison with Problems Reported by Inner-City Teachers (The NDEA National Institute in Teaching Disadvantaged Youth, Occasional Paper/Five. Washington, D. C.: The American Association of Colleges for Teacher Education, 1968)

an assumption was made that learning a strategy for solving problems would help teachers solve more classroom problems in more satisfying ways. The intention of the study was to devise a means, which took the form of a simulation, for causing teachers to do things that would make it more probable that they would achieve their goals. The simulation was not at all concerned with changing a teacher's goal. What it was concerned with was that what the teacher said was the goal was also the goal he was actually trying to achieve. If the teacher's goal was really to eliminate Jack's disruptive behavior then the teacher should be helped to learn how to do that. At the same time the teacher should be forced to examine his perception of the problem so that he would be clear about what problem he was attempting to solve. While some teachers appear to respond intuitively with great success to problem situations, there are many others whose intuitive responses aren't so successful. Engaging in the analysis of a problem for the purpose of suggesting solutions was believed to be a process whereby a clearer perception of what problem was to be solved would be obtained. Support for the belief comes from (1) recordings of individuals' thinking aloud while attempting to solve problems and (2) working computer models of problem-solving and decision-making behavior of individuals acting in a variety of roles. Evidence from these sources indicates that individuals who successfully solve complex problems first break them down into smaller sub-problems and attempt to solve them. These are the reasons why the simulation is concerned primarily with modeling and teaching a process.

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[5]Donald R. Cruickshank, John J. Kennedy and Betty Myers, "Perceived Problems of Secondary School Teachers" (The Ohio State University, 1974) (in progress)

How the simulation would accomplish the intention.

The simulation was to provide a framework in which the teacher trainee's participation would be demanded and the kind of participation would be controlled. This would insure that between the time when the trainee recognized a problem and the time when he proposed a solution for it, he would have analyzed it carefully in order to attempt to propose solutions that would be consistent with the problem he perceived. Requiring this kind of participation was intended to increase the probability that the trainee would select a solution that could result in the consequence he desired. This is analogous to the training of pilots who practice making judgments and performing tasks in the safe environment of a simulated flight. Similarly, through his participation in the simulation, the teacher trainee will practice using a strategy for solving classroom problems. The question to be answered next was what was the critical characteristic of a solution that would be evaluated as successful in the simulation.

The "consistency" of a solution.

With respect to this question an assumption was made that teachers find it difficult to resolve classroom problems satisfactorily because, although they may have a notion of a desired goal, what they have perceived to be the problem, or the action they are taking to eliminate it, or both, are not consistent with the goal. For this reason the criterion to be used by the computer to guide the process was to be that of "consistency." To be consistent meant that the problem solver had to perceive clearly what problem he was trying to solve so that he would be able to relate the content of each step of the problem-solving process, such as a consequence or a solution, to the specific problem. In the next section the problem-solving strategy to be used is described.

The problem-solving strategy.

A strategy that the teacher trainee was to use to analyze each problem required the answers to eight questions. The same strategy was to be the basis of the computer program. The goal of the trainee was to respond to each question in sequence so that the response he gave would be evaluated as consistent with the previous responses. The trainee would imagine himself in the role of the teacher. The questions that form the strategy are listed below.[6]

(1) What is the real problem?

(2) What goal do you want to achieve that would be consistent with the problem you have identified?

(3) What forces, consistent with your goal, might be preventing your achievement of the goal?

(4) What forces, consistent with your goal, might be helping you to achieve your goal?

(5) Which of the forces are really the effective forces in this problem?

(6) What can be done to strengthen or weaken any of these forces? (Here you are proposing solutions. Suggest at least five.)

(7) Which solution is the most realistic to try?

(8) What specifically do you expect to happen as a result of trying the solution?

It is possible that the particular problem-solving strategy represented by these eight questions is inappropriate but the fact is that some strategy must be specified. Alternatives could be considered if criteria

[6]The source of these eight questions was a modification of a problem-solving paradigm adapted from Lewin and Schmuck's work by Donald R. Cruickshank of The Ohio State University. It was further modified for use in this project.

for selecting a better strategy could be identified.

With reference to the filmed illustration, some viewers might say that Pat Taylor perceived the problem to be that Jack's behavior was disruptive to the other pupils. That would be the first step in the problem analysis. Almost any interpretation of the problem would be acceptable. The teacher's goal might then be to re-establish conditions for learning in the class. That statement of a goal would be the second step. Whatever solution was selected for this problem it could be expected to have the effect of decreasing Jack's disruptive behavior and at the same time not be more disruptive than Jack was. A rule would be specified to insure that the second step of the problem-solving strategy would be consistent with the first step, the third with the second, and so on. This leads up to the question of why a man-machine simulation was selected as the most appropriate means for teaching the trainees how to propose solutions to match their goals.

The appropriateness of a man-machine simulation.

Simulation is commonly recognized to be useful for providing a frame of reference for the learner and then directing his activity within it. In the model discussed herein the frame of reference is a problem-solving strategy and the teacher trainee is to be directed in the use of the strategy for analyzing a classroom problem while following the rule called "consistency." Since the analytic process was very specifically defined it was considered appropriate to have the trainee's use of the process monitored by a machine. Responses that did not follow the rule would simply not be "heard" by the computer and the trainee would be unable to progress to the next step. The program itself would be methodical so no distractions would be possible. The rule to be specified must be content-free. That is, it should be a rule that would be applied to evaluate only the

relationship between steps. The content of any one step could not be evaluated because it would not be meaningful with respect to this criterion. It is the content of two steps relative to one another that would be meaningful. This critical relationship between two steps is "consistency." It should be remembered that the ultimate purpose of the simulation is to teach an analytical process conceived to be a skill that could be acquired through practice. Next, what would be occurring during the use of the simulation?

The simulation in use.

Before discussing the use of the simulation, I believe that I need to place it in the context in which I originally conceived of its use. It was only after becoming somewhat familiar with two simulated teaching-problems-laboratories[7,8] and recognizing their potential for commanding the involvement of participants that the development of another simulation specifically to teach participants a problem-solving strategy seemed potentially useful. It's difficult to imagine that taking any classroom problem out of the context of a specific school situation could command much involvement from inexperienced, preservice teachers. But if they were already participants, acting as teachers, in a believable, simulated school and if they were sufficiently involved to feel how it would be to really have these problems, then they might also be willing to learn a strategy to help them solve the problems. Now the use of the simulation to teach the strategy will be described.

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[7]Cruickshank, Broadbent and Bubb, Teaching Problems Laboratory

[8]Donald R. Cruickshank, Inner-City Simulation Laboratory (Chicago: Science Research Associates, Inc., 1969)

The trainee would have encountered the problem to be solved and would have attempted to propose several solutions for it by following the eight steps of the problem-solving strategy being used here. He would know that the content of each step was to be consistent with that of the other steps. When he had completed his analysis independently then he would go to the computer to have his solution evaluated. A record of the dialog between the teacher trainee and the computer during the use of the simulation would show multiple exchanges of questions and answers between them. After the trainee had announced his presence, then one step at a time the program would request the information needed in each step of the process. An answer to each of the eight questions would be requested by the computer, given by the teacher trainee, evaluated by the computer and finally accepted or rejected by the computer. The final step would be the proposal of several solutions which, like the content of all the intervening steps, would be required to be consistent with the problem definition. The response to one step would have to be satisfactory before the computer could respond to the next step. Next, how would the trainee know when he was successful?

How the trainee's success in the simulation would be demonstrated.

After responding at each step and arriving at the end what would the trainee have demonstrated? By reaching the end he would have demonstrated that he could satisfy the computer's demand to be "consistent" in the use of a specific analytical process for solving a specific problem. In order to meet this criterion, the statement of the problem definition, the statement of the expected consequence and the statement of the solution to be used to achieve the consequence all had to have the same perception of the problem as their common reference point.

The plausibility of a solution.

Though not inherent in the simulation it seems desirable that being able to suggest a solution that is plausible as well as consistent would be a second achievement for the trainee to demonstrate. If the solution he proposed satisfied the criterion of consistency then in addition it should be evaluated as "plausible" or "not plausible" according to the judgments of experienced teachers and peers. A plausible solution should be one that experienced teachers would agree could be tried and might result in achievement of the teacher's goal. It is hypothesized that experienced teachers would agree that how a solution is used and how appropriate a specific solution may be for use by any given individual are often as important determinants of the effectiveness of the solution as the content of the solution. Peer feedback about the appropriateness of solutions proposed for use by specific individuals may help trainees learn to use the analytic process they practice to propose more solutions that will be effective for themselves as well as consistent with the perception of the problem.

An obstacle.

The model described herein is presently inoperative. One reason for this is the lack of an explicit definition of consistency that could be used by a computer program. That consistency is a necessary condition of a problem-solving process is supported both by logic and by examination of processes followed by successful problem solvers. It is clear that if successive statements have different, unrelated referents then using the statements to arrive at a predetermined point, the teacher's goal, would be impossible. Not only do successful problem solvers break complex problems into simpler ones but they also tend to apply the rules by which they attempt

to resolve the simpler problems in a similar sequence. What could be the reason for the sequence unless the content of one step was related to and used in another step? It's this relationship to which the criterion of consistency is to be applied. Before the simulation can be used the criterion must be defined operationally.

Appendix

Description of "Critical Teaching Problem I" from the Teaching Problems Laboratory

Scene opens with Pat Taylor working in a small reading group in front of the room. As Pat scans the class, Jack Brogan is noticed as he stretches, yawns aloud, and gets up from his chair. He walks to the pencil sharpener, noisily grinds his pencil, breaking the point several times. Children in the reading group are distracted from their silent reading. Jack moves toward his seat but as he passes Jeffrey Knew he reaches down and closes Jeffrey's book. A minor disturbance occurs and Pat Taylor requests Jack to sit down and finish his work. Jack does. The reading group and class return to work. Soon Jack is seen to disturb Sue Carpenter, the girl sitting next to him, eventually taking her paper from her desk. She shouts, "Jack, give me back my paper!" Pat Taylor declares, "Jack, that's enough from you!" He appears to go back to work but soon crumples up his paper and throws it on the floor as the scene ends. (From a production script.)[9]

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[9]Donald R. Cruickshank, Simulation as an Instructional Alternative in Teacher Preparation (Washington, D. C.: Association of Teacher Educators, 1971)